BIOTIC COMMUNITIES

F.

The information contained within this section lists some fauna found in the Meramec River basin; however, it is not a complete list. Although the aquatic ecosystem is inextricably connected with the terrestrial ecosystem, the emphasis is the stream ecosystem. Other basin surveys, such as the Environmental Inventory of the Meramec River basin by Rychman, Edgerley, Tomlinson, and Associates, Incorporated, have detailed the entire Meramec River ecosystem with existing information (RETA 1973).

F.1. FISH COMMUNITY INFORMATION

F.1.1. Sampling Protocol

Fisheries biologists with the Missouri Department of Conservation (MDC) performed fish community collections on streams within Meramec River basin to evaluate changes in composition, distribution, and relative occurrence on fish species. In addition, stream fish communities that MDC did not survey in the past were sampled more completely. William Pflieger of MDC's Fish Research Section used mostly drag-seines or kick-seines for his collections. The size variation between the two seine types allowed sampling of different habitats and different fish species. Generally, drag-seining is selective for nektonic species (those fish found swimming above the substrate), and kick-seining is selective for benthic species (smaller bottom-dwelling forms). Electrofishing can be size and species selective and therefore, like seining, may not completely assess the fish community composition. The Research Section, typically, used the drag-seine for pool and run areas and the kick-seine for riffles that contained benthic species. East Central Region Fisheries Staff used electrofishing as the primary sampling method and supplemented some collections with seining.

The regional fisheries staff employed similar techniques to the SHAD site selection process for the fish community site selection. In fact, regional fisheries personnel sampled at least one fish collection site for every stream with habitat evaluations (SHAD). Larger streams required more effort; therefore, streams of larger size had multiple sites. Generally, collection effort depended on the stream size and stream order. The stream order and gradient were important determinants in site selection.

F.1.2. Fish Community Species List and Years Collected

Since 1930, MDC fish biologists have collected a diverse assemblage of 125 fish species from the Meramec River basin. The Fisheries Division Research and Management fish collections were combined into a comprehensive fish species list of the 124 species names and the corresponding occurrence year (Table 18). A cavefish species *Typhlichthys subterraneus* (Southern cavefish) found at Maramec Spring Park brings the total to 125 fish species (see Table 15, subsection E.2.2). The species list was divided into large, nektonic, and benthic species, a division created by William Pflieger that allowed sampling adequacy comparisons. Because of differences in the collection techniques between research and management, a species present within only one collection may be attributable to many factors, including sampling gear type. The large group consists of species that grow to six inches or more in total length as adults.

Several fish species were found in one collection but not the other collection. For example among the large species collected only by Fisheries Research were the northern pike, spotted gar, blue sucker, and pumpkinseed. Among the large species collected only by Fisheries Management were the white catfish, bowfin, brown trout, striped bass, spotted bass, and creek chubsucker. Most notable species among the benthic species collected only by Fisheries Research were the mud darter, stonecat, Ozark logperch, and suckermouth minnow, and those collected only by Fisheries Management were the mottled sculpin and the fanned tail darter. The nektonic species disparity between the two collections was somewhat greater and many are species collected solely by the Fisheries Research from 1950-60.

F.1.3. Seine data (Research Fish Collection)

Fish collections by various individuals at Missouri Department of Conservation's Fisheries Research Section are contained within a collective fish community database (otherwise known as William Pflieger's fish database). Fisheries Research Section compiled fish sample collections of 89 localities from 1930 and nearly every decade after 1930 for a comprehensive historical perspective of changes in species diversity and species composition. Research personnel of the Missouri Department of Conservation made the following collections:

- 5 collections in 1930's,
- 18 collections from 1941-46,
- 4 collections from 1947-54,
- 32 collections from 1958-65,
- 6 collections from 1967-69,
- 19 collections from 1974-77,
- 7 collections from 1982-84,
- 7 collections in 1992.

Fisheries biologists made 23 collections in 1963, making this the predominant collection year. The strength of this database lies in the long-term collections, but researchers had few collections to allow individual site comparisons on the temporal scale. Biologists made successive collections on the following individual sites:

- site #375 on the Dry Fork (RM 6.0) sampled in August 1941 and again in October 1992.
- site #389 on the Upper Meramec River (RM 217.0) sampled in October 1933, 1963, 1984, and October 1992.
- site #353 on the Upper Middle Meramec River (RM 114.0) sampled in August 1941, 1963, and March 1977.

F.1.3.1. Fish Species Diversity

Diversity is often equated with variety or complexity. From an ecological perspective, diversity depends on the number of individuals present and the evenness with which the individuals are distributed among these species. Simpson's Diversity Index is the probability that two individuals chosen at random from the population will belong to the same group. Consistent with Strahler (1952), within higher-order streams, diversity remained high. Also, some stream segments sampled within a watershed demonstrated

increasing diversity with increasing order. The Meramec River (seventh order) had the highest diversity. Although sampled more intensively, fourth-order streams had the largest variation in diversity. Because of differences in number of sites sampled and stream orders sampled within watersheds, comparing diversity among watersheds was difficult.

F.1.3.2. Fish Species Relative Composition

Differences in fish species composition in streams across basins may be due to the physical habitat, energy resources (food abundances), water quality and watershed characteristics, flow regime, and biotic interactions. In addition, seining methods are selective for certain taxonomic groups. Species composition shows species numbers relative to the total number of specimens collected. The fish community summaries of each watershed within the Meramec River basin were the result of seine efforts and species enumeration. Within Pflieger's fish database, researchers categorized sample sites as adequate (all species collected were counted), marginal (a random sample was counted), or inadequate (not all specimens collected were counted).

For each USGS 11-digit watershed within the Meramec River basin, a percentage species composition was calculated for adequately sampled sites from 1930-1992. We found five species that generally had the highest percentage composition within each individual Meramec USGS 11-digit watershed. Relative composition was highest for longear sunfish, central stoneroller, northern hogsucker, black redhorse, and bluntnose minnow. Shiners, especially the bleeding and bigeye shiners, occasionally comprised the highest percentage composition within a watershed.

Relative dominance of fish community family components varied only slightly across watersheds. Percid, centrarchid, catostomid, and cyprinid families were the dominant families within all watersheds. The cyprinid component was always the most numerous and diverse, comprising up to 90% of the specimens collected. Number of cyprinid species varied from 16-36 from the headwaters (Dry Fork and Upper Meramec River) to the Lower Meramec River watershed. The number of catostomid and percid varied from 4-13 and 7-16 species, respectively, from the Upper to Lower Meramec River watersheds.

The observed differences in sucker and darter species (considered intolerant to pollutants) composition across watersheds were probably due to a combination of sampling bias, underlying geology, and fish habitat selection within the basin. In addition, the higher-order streams have greater habitat diversity than lower-order streams, which may contribute to the difference in species composition. Within the Dry Fork, percentage composition of suckers within the Dry Fork watershed, was relatively low (0.3%) compared with other watersheds that had between 7% (Lower Meramec River) and 45% (Courtois Creek). Compared with other watersheds, however, darters (as Percidae) were relatively high in composition (5.9% compared with 2%-5.5% for other watersheds).

Finally, the number of Centrarchidae species were relatively stable across watersheds. Smallmouth bass numbers exceeded largemouth bass in all watersheds except Dry Fork. Within the Dry Fork watershed, green sunfish (3.77%) and largemouth bass (1.74%) were the predominant Centrarchidae species. The adjacent watershed, Upper Meramec River, longear sunfish were predominant and rock bass and smallmouth bass, nearly as dominant. Fewer largemouth bass were collected in the Indian Creek watershed. Indian Creek had the lowest number of centrarchid species compared with other watersheds (East Central Region fisheries biologists believe the low percentage composition of centrarchids was due to sampling biases).

F.1.3.3. Fish Species Relative Occurrence and Historical Occurrence

Percent occurrence was determined for all sites. Among all watersheds the central stoneroller and the longear sunfish occurred most often within sample sites, indicating a wider distribution compared with other species. The bleeding shiner and the wedgespot shiner also occurred frequently.

Two species of fish in the Meramec River are migratory, found only within systems that have not been affected by Mississippi River lock and dams. Listed as rare in Missouri, the Alabama shad (*Alosa alabamae*) is the only truly anadromous fish species of this region (Pflieger 1975). Adults migrate up the Mississippi River to spawn on the sand and gravel of the Meramec River. Historic and recent collections have found small numbers of juvenile Alabama shad in the Lower Meramec River watershed, including the Big and the Bourbeuse rivers. Similarly, another migratory species, the American eel, is the only catadromous fish species in this region. Adults live in fresh or brackish waters and return to the Sargasso Sea near Bermuda to spawn. In historic and recent collections, biologists have found eels in the main stem Meramec River.

F.1.4. Electrofish and Seine Data (Regional Fish Collections)

Fish sampling was completed by MDC Fisheries Management Biologists in the St. Louis and East Central regions from 1986-1996. From 1986-1996, 97 sites were sampled by regional fisheries personnel, and 104 species were collected. Biologists sampled the following number of sites within each basin:

- Dry Fork watershed, 11 sites in 1995;
- Upper Meramec River watershed, 11 sites in 1995-96;
- Huzzah Creek watershed, 10 sites in 1992, 1995;
- Courtois Creek watershed, 11 sites in 1995;
- Upper Middle Meramec watershed, 10 sites in 1986, 1994, 1995-96;
- Indian Creek watershed, 9 sites in 1992, 1994-95;
- Lower Middle Meramec watershed, 17 sites in 1986-87, 1991-92, 1994-96;
- Lower Meramec watershed, 26 sites from 1986-91.

F.1.4.1. Species Diversity

Simpson's Diversity Index was used to evaluate species diversity in the Regional fish collections. Sampled segments of third-order streams sustained the highest diversity compared to other stream orders. Some third- and fourth-order streams are direct tributaries to the larger-order streams, and give fish a greater number of niches. Antire and William creeks had high species diversity and are fourth-order tributaries to the seventh-order Meramec River within the Lower Meramec River watershed. Their watersheds are relatively undeveloped compared to those of Grand Glaize and Fishpot creeks, which are also fourth-order tributaries but had lower species diversity. Within the Lower Middle Meramec River, main stem sample sites had poor diversity. Likely, adequate fish samples were difficult to obtain at these sites, so were sampled for target species only. Pierce Creek, a tributary to the Little Meramec River, had the highest diversity for sampled sites within this watershed. All Indian Creek sample sites were moderate in diversity. Sampled sections of the Huzzah Creek watershed exhibited higher species diversity than sites within the Courtois Creek watershed. A particularly poor diversity value was found in

Shoal Creek in the Huzzah Creek watershed. Of the eight USGS 11-digit watersheds, the Upper Meramec River and Dry Fork watersheds were more diverse than the other six watersheds.

F.1.4.2. Fish Species Relative Composition and Occurrence

The relative densities of species components were varied between watersheds, although some watersheds exhibited similarities. Basinwide, dominant minnow species collected by Fisheries Management personnel were the central stoneroller and bleeding shiner. Densities of these species were lower in the higher-order streams systems, especially in the Lower Meramec River watershed. These species were generally restricted to small, clear upland streams. Dry Fork, Indian Creek, and Lower Middle and Upper Middle Meramec River watersheds had more central stonerollers than Huzzah Creek, Upper Meramec River, Lower Meramec River, and Courtois Creek watersheds, which had more bleeding shiners. The Upper Middle Meramec River watershed had the highest number of minnow species, and the main-stem Meramec River watersheds possessed more minnow species than the Huzzah Creek, Courtois Creek, or Indian Creek watersheds.

The dominant darter species were the northern orangethroat darter, rainbow darter, barred fantail, and Missouri saddled darter. The main-stem Meramec River watersheds from headwaters to mouth had more darter species than either the Huzzah Creek, Courtois Creek, and Indian Creek watersheds. Darter species were not found frequently in the Lower Meramec River, but a state-listed endangered species, the crystal darter, was found in small numbers. The northern orangethroat was well distributed throughout the Meramec River basin and had fairly high densities relative to other darters. The cobble substrates found in the basin's watersheds made habitat ideal for darters. Gravel substrate found in riffle areas was too small for darters to use as cover. Other percids, sauger and walleye, were found only in the Lower Meramec River watershed in this collection.

The northern hog sucker was the dominant sucker species in the Dry Fork, Huzzah and Courtois creeks, and Upper Meramec River. The black redhorse and the golden redhorse were abundant in the Upper Middle Meramec River and the Lower Middle Meramec River, respectively. Within Indian Creek few sucker species were collected by Fisheries Management personnel. Anglers, however, have reported catching suckers. Also, within the Dry Fork only one site had sucker and darter species. Finally, the number of sucker species increased from three species to 14 species from upper to lower Meramec River basin.

Important as sportfish, dominant centrarchid species were the green sunfish, longear sunfish, and the bluegill sunfish. Black and white crappie were only found within the Lower Meramec watershed. In addition, the Lower Meramec watershed supports a modest but growing population of spotted bass. Fisheries biologists are concerned about the growing number of spotted bass in this area because of the high relative composition as compared to smallmouth and largemouth bass and because of the increasing hybridization with smallmouth. Distribution of smallmouth and largemouth bass ranged from the Dry Fork to the Lower Meramec River. Throughout their range, smallmouth bass dominated the sample except in the Dry Fork, Lower Meramec River, and the Lower Middle Meramec River watersheds, where largemouth bass dominated the sample. Rock bass occurred most frequently in the Courtois, Huzzah, Lower Middle Meramec watersheds, and least frequently in the Dry Fork and Lower Meramec watersheds.

The Meramec River fish assemblage has apparent differences in fish species from the upper to lower Meramec River basin that are of interest to anglers. Particularly noteworthy is the presence of the channel catfish, flathead catfish, freshwater drum, paddlefish, and the shortnose and longnose gars in the lower Meramec River basin, especially the Lower Meramec River watershed. The gar species have established themselves in the sand-and-gravel pit lakes that are found in the lower Meramec River basin. Other species include the temperate basses, the white bass and striped bass, collected primarily in the Lower Middle Meramec River and Lower Meramec River watersheds.

F.2. AQUATIC INVERTEBRATES

F.2.1. Mussels

Although many surveys of naiades have been conducted in the Meramec River basin, little information was collected on the distribution and relative abundance of mussel species. The Missouri Department of Conservation conducted a survey of naiad fauna from 198 sites during April 1977 to November 1978 (Table 19) under contract by the Army Corps of Engineers (Buchanan 1980). Historically, two individuals published mussels species lists for this watershed. Grier (1915) published the first mussel species list of the Meramec River. Utterback's list (1917) for the entire Meramec River basin (including the Bourbeuse River and the Big River) included 24 mussel species. Other studies, conducted in the 1960s and 1970s, revealed about 46 species of mussels within the entire watershed (Meramec, Bourbeuse, and Big rivers), showing that Utterback found about half the mussel species. Of the 42 species within the Meramec River portion, eight naiad species (Amblema ligamentina., Amblema p. plicata, Lampsilis r. brittsi, Megalonaias nervosa, Quintardi pustulosa, Elliptio dilatata, Cumberlandia monodonta, and Potamilus alatus) comprised 80.9% of the living naiades found (Table 19). Of those species Amblema o. olicata and A. l. carinata comprised about 48%. Within Dry Fork the dominant species was the Lampsilis siliquoidea (35%). Lampsilis reeviana brittsi was the dominant species for both the Huzzah Creek (96%) and Courtois Creek watersheds (76.9%). After creation of the Federal Endangered Species Act, the spectaclecase (C. monodonta) was listed as endangered in 1971 (Oesch 1995). After being listed as endangered in Missouri, several large populations were found in the Meramec and Gasconade rivers. Presently, Missouri has the largest population of spectaclecase mussels in the United States.

F.2.2. Crayfish

Surveys conducted by the Missouri Department of Conservation, have identified eight crayfish species in the Meramec River basin (Table 20 and Table 15, subsection E.2.2). A unique crayfish species found in the Maramec Spring system is the cave crayfish (*Cambarus hubrichti*), which inhabits the subterranean spring system. Of the eight known crayfish species, the saddlebacked crayfish (*Orconectes medius*) was dominant (57.9%); however, sampling was not evenly distributed throughout the basin (Table 20). Sampling showed that the saddlebacked crayfish was a dominant species within the upper reaches of the Meramec, especially the Courtois Creek watershed. High relative abundance of the saddlebacked crayfish indicated that habitat conditions were more appropriate in the Courtois Creek watershed. The devil crayfish, which lives in burrows in timbered and formerly timbered areas along the floodplain of streams, was the least abundant species with only one specimen found within the Upper Meramec watershed. A few woodland crayfish were collected in the Huzzah Creek watershed. Finally, one state watchlist species, the Big River crayfish (*Orconectes harrisoni*), was collected in the Lower Meramec River watershed. The Big River crayfish is a medium-small, tan-colored crayfish with distinctive olive-green and reddish-brown bands on the abdominal segments. It is indigenous to the Big River and its tributaries of the eastern Ozarks.

The upper Meramec River, from river mile 13-50, and Courtois Creek exhibited the most diverse assemblages of crayfish species (Table 21). Field sampling, however, indicated that the first 116 miles of the Meramec River was the richest area.

F.2.3. Benthic Insects and Other Invertebrates

Aquatic insects have been considered indicators of water quality. Several commonly found aquatic insects orders in the Meramec River basin were: Plecoptera (stoneflies), Ephemeroptera (mayflies), Odonata (dragonflies, damselflies), Trichoptera (caddisflies), Coleoptera (beetles), Diptera (flies, midges), Megaloptera (alderflies, dobsonflies, fishflies), Lepidoptera (butterflies, moths), and Hemiptera (true bugs). The species within the order's Plecoptera, Ephemeroptera, Trichoptera, including the water penny, riffle beetle, the gilled snail and dobsonfly are considered sensitive organisms (Merritt and Cummins 1978). These species are often found within clear, well-oxygenated, unpolluted streams such as the Meramec River (Table 22).

F.3. WETLAND SPECIES

Wetlands function as spawning, nurseries, adult feeding and refuge habitats of selected fish species. Many rare and endangered species use wetlands for all or part of their life cycle (MDC 1994). Approximately 43% of the threatened and endangered species within the U.S. use wetlands directly or indirectly for survival (EPA 1993); six percent of the species were listed as rare within the state of Missouri (Table 23). According to the Guidelines for Promoting Fishery Resource Benefits in Missouri Wetlands (MDC 1994), the Meramec River basin has 35 fish species that use wetlands for part of their life cycle. One crayfish species, the devil crayfish, utilizes and builds earth mounds in the floodplain of streams. Finally, the Asiatic clam, an exotic mussel species, and three other native mussel species known to inhabit wetlands, the giant floater, mucket, and lilliput were found within the Meramec River Basin.

Promoting the protection and proper hydrologic functioning of stream-recharge areas, cutoff ponds, and riverine wetlands could enhance water quality and thus, the fish community. Using the National Wetland Inventory database for the Meramec River basin, we will be able to better select areas or sub-watersheds for future landowner agreements. Lastly, the flood buy-out lands purchased through the Federal Emergency Management Agency and SEMA (State Emergency Management Agency) will aid in protection of riparian wetlands, possibly by allowing proper functioning of these zones.

F.4. RARE, THREATENED, AND ENDANGERED AQUATIC FAUNA

Differing fauna are thought to have contributed to the decline of some aquatic species within the Meramec River basin, but the factors generally point in the direction of habitat destruction or cumulative habitat degradation. For instance, the decline of the Meramec's mussel fauna is attributed to the loss of stable substrates due to bank and channel degradation (Roberts and Bruenderman 2000). A locational list of the sensitive species within the basin can be found within the Natural Heritage database (the database is updated periodically with recent locations and new species). Included in this list are seven different species of amphibians, six species of fish, three cave-dwelling crustacean species, 11species of mollusks, four species of aqutic insects, four species of mammals, and four avian species that occur within the Meramec River basin (Table 15, subsection E.2.2).

Mollusks, the most endangered group, include one federally endangered species, the pink mucket

(*Lampsilis abrupta*). At present, the known range of the pink mucket in Missouri's Meramec River basin extends from the Shaw Arboretum in Gray Summit, MO to the confluence with the Mississippi River (see F.7 *Other Management Efforts and Research Efforts*, regarding a recent survey).

Along with habitat destruction, another factor contributing to decline in mussel species, was the button manufacturing industry. This industry used mussel species from the later 1880s to World War II, whereupon plastics replaced their use. Once button manufacturing plants depleted mussel beds within one stretch of river, they would move in search of newer beds.

Today, no commercial harvesting of mussels is allowed within the Meramec River basin (MDC 2001). In 1995, the Missouri Department of Conservation seized several tons of illegally harvested mussels. A recent innovation in Japanese cultured pearl industry has created a resurgence in mussel collecting (Kohne 1995). A bead from the mussel shell is implanted within the oysters to start a cultured pearl.

In the Ozark Border region, several rare, threatened, and endangered fish species are found within the lower 93 miles of the Meramec River (Table 15; subsection E.2.2). According to the MDC Research fish collection, Dry Fork, Huzzah Creek, Courtois Creek, and Indian Creek have no endangered species. In the combined Natural Heritage database and the MDC Research historical fish collection, the State of Missouri lists two endangered, six watchlist, five rare, and one extirpated species in the basin. The flathead chub, found at the confluence of the Mississippi River, has recently been federally listed (MDC 1995a). The crystal darter and the blue sucker were once considered candidates for listing and now are considered species of concern. The blue sucker was once found within the lower 36 miles of the Meramec River. They have not, however, been collected since 1963.

Of the six aquatic invertebrates listed in the Natural Heritage database, two species are watchlist species--*Agapetus artesus* (Artesien caddisfly) and *Stygobromus onondagaensis* (Onondaga cave amphipod). *Leucotrichia pictipes* (a micro caddisfly) is found in Crooked Creek and has an undetermined status. The cave-dwelling springtail, *Sinella auita*--state listed as rare-- is found within three caves, Fisher, Fox, and Great Scott. Two other state-listed rare species are the *Allocrangonyz hubrichti* (Central Missouri cave amphipod) and the *Ophiogomphus westfalli* (Arkansas snaketail dragonfly). The Central Missouri cave amphipod is found at Maramec Spring and the Arkansas snaketail dragonfly at Meramec State Park (Linden Trail, personal communication). Other collections, performed by Fisheries Research biologists, contain three additional state-listed species. *Serratella frisoni*--found within the Huzzah and Courtois creeks--and *Baetisa abesa*--found within the Meramec River--have undetermined status. *Glyphopsyche missouri*, found at Maramec Spring, is endangered in Missouri.

F.5. ANGLER SURVEY

F.5.1. Historic Angler Surveys

Techniques to assess and manage stream fisheries resources have evolved within the last 50-60 years. In the 1930s, the Fish Commission performed direct surveys of Missouri's streams on a regular statewide basis. During the 1950s, they stocked an 80-mile section of the Big Piney River to assess the implications of stocking as fishing improvement. Based on this study and an additional study on the Current River, the Fish Commission concluded that stocking was not likely to improve bass fishing. Still, little information was available about potential fishing improvement techniques. Angler surveys have been a cost-effective means of gathering important biological information on fish, such as assessing rates of harvest, and determining the needs of anglers, among others.

From 1958-69, George Fleener conducted a quantitative creel survey on Huzzah and Courtois creeks during March 15-November 30 (ten consecutive-year seasons). The objectives were to estimate fishing pressure and catch on 5.37 miles of Huzzah Creek and 6.25 miles of Courtois Creek. Both Courtois and Huzzah creeks have higher fishing pressure than Big Piney Creek and the Current River. Concern for the large contribution of the smallmouth bass less than 12 inches in the creel and extremely high fishing pressure, led to experimental regulations on the Huzzah and Courtois creeks.

The Missouri Department of Conservation believed regulation would improve fishing quality. From January 1, 1969 to January 1, 1974, they imposed a "fish-for-fun" regulation on a 6.2 miles section of Courtois Creek (Table 24). Also, during 1969, they imposed a 12-inch minimum length limit on the Huzzah Creek. Several surveys listed in Table 24 assessed the merit of the regulation. These studies concluded that a 12-inch minimum length limit had beneficial effects on the fishery and met with public acceptance. Consequently, on January 1974, the Missouri Conservation Commission approved the black bass 12-inch length limit for statewide use on Missouri streams.

F.5.2. Recent Angler Surveys

A survey conducted from 1978-79 on a 74-mile segment of the upper Meramec River found that all types of fishing made up about 10% of all visits (Fleener 1988). In the 117-mile lower segment of the Meramec River, pole-and-line fishing was popular, making up 15% of all visits to the area (Fleener 1988).

A study on two segments (the lower segment--Bass River Resort Campground to Huzzah Creek and upper segment--Misty Valley Campground to Bass River Resort Campground) of Courtois Creek was initiated 11 years after Fleener's study to determine if a catch-and-release fishery would be biologically appropriate for the lower Courtois Creek (Smith 1991). One segment was the same sample segment as that used in the 1969-73 fish-for-fun evaluation. The central objective of the 1991 investigation was to determine the biological need to manage the smallmouth bass fishery with a more restrictive regulation than the existing 12-inch minimum protected length limit. Based on comparisons to historic population indices, growth data, and creel surveys, East Central Region Fisheries staff determined that a catch-and-release regulation would not meet the public's expectation of higher catch rates and larger fish (Smith 1991). In a 1977 survey conducted by Fajen (1981), mean catch rate was 0.94 fish/hour, while in the 1991 survey conducted by Smith, the catch rate was 1.69 fish/hour.

In addition, the Meramec River Special Trout Management Area (a coldwater sport fishery on the Meramec River from Highway 8 to Scott's Ford) was assessed for valuable angler use information in 1996 and 1997. Over 4,000 fishing trips per year were made to the area. It took anglers less than 2 hours to catch a trout and an average of 16 hours to catch a trout greater than 15 inches.

Within the last few years, the Department of Conservation conducted several additional creel surveys of portions of the Meramec River watershed. From April 1991-October 1996, East Central Region Fisheries personnel conducted yearly creel surveys to assess the effectiveness of the 15-inch smallmouth bass management regulation on the Smallmouth Bass Stream Management Area (SMB SMA) from Scott's Ford to the railroad crossing at Bird's Nest (15 miles). The creel survey on the SMB SMA had four stations: Indian Springs, Riverview Access, The Rafting Company (Highway 19), and Bird's Nest. Onondaga Cave State Park was used as a control. Before the effects of the regulation change could begin to be realized, it took bass anglers an average of 11.3 hours to catch a smallmouth bass greater than 12 inches in the SMBSMA and 11.7 hours in the control area. Even greater improvements in the

smallmouth bass population have been documented in electrofishing surveys of the two areas. For example, in the 1995 comparison of the regulation area versus control via electrofishing samples, improvements in the 12- to 15-inch smallmouth bass size range, as well as a 27% greater PSD (Proportional Stock Density) over the control.

Finally, hatchery personnel conducted a creel survey on Maramec Spring Park as part of a survey of Missouri's four state trout parks. Personal interviews were conducted with 2,057 anglers by means of a walking roving survey during 96 sampling periods for March 1, 1996 to October 31, 1996. The survey yielded results pertaining to angler demographics and characteristics, opinions and attitudes, satisfaction, success, and catch rates (Stanovick 1998).

F.6. COMMERCIAL HARVEST

As specified in 3CSR10-10.726 of the Wildlife Code of Missouri (1996), no commercial harvest of fish or mussels is allowed in the Meramec River basin. Mussels may be taken from commercial waters in any number with certain size restrictions (Wildlife Code of Missouri, 1996).

F.7. OTHER MANAGEMENT EFFORTS AND RESEARCH EFFORTS

In addition to the commitment to enhance fishing quality and opportunities in the Meramec River basin, the Missouri Department of Conservation is a partner in protection of aquatic resources.

Part of aquatic resources protection involves researching species distribution. A mussel (naiades) study on the lower Meramec River (lower 55 miles, 1 mile upstream of Interstate 55 bridge, upstream to the mouth of the Bourbeuse River) was contracted in 1996 by the USFWS, Columbia, Missouri. The last comprehensive survey on the Meramec River was conducted by the Missouri Department of Conservation. In the survey conducted by Alan Buchanan in 1977 and 1978, mussels were sampled in 15 sites from the mouth of the Bourbeuse River to the mouth of the Meramec River. The intent of the study was to obtain population characteristics of federal, state-listed, and candidate freshwater mussel species. In the USFWS study an important work component was to focus on evaluating the pink mucket (*Lampsilis abrupta*) population viability status. This component was part of a statewide pink mucket survey and recovery plan. The species will be considered viable (a single disturbance-event does not eliminate the species) when at least five viable populations are found. Finally, a 1997 mussel survey of approximately 75 sites covering the Big, Bourbeuse, and Meramec rivers was performed by Sue Bruenderman of MDC Fisheries Research.

F.8. FISHING REGULATIONS

The Wildlife Code of Missouri contains specific information about the statewide fishing regulations (creel limits, size limits, seasons and gear) that apply to the Meramec River. All statewide stream fishing regulations apply to most streams within the basin. To assure the continued quality of fishing within the Meramec Basin, however, special management areas for particular species are in effect.

A Smallmouth Bass Stream Management Area is found on the Meramec River from Scott's Ford to the railroad crossing at Bird's Nest (15 miles). Black bass regulations within these areas are as follows: 1) Daily limit is six, in aggregate including smallmouth bass, largemouth bass, spotted bass, and all black bass hybrids, and 2) with a 12-inch minimum size limit; 3) Bass may not be taken from March 1 to the Friday before Memorial Day. Within the Smallmouth Bass Management Area, however, no more than one (1) of the six black bass taken can be a smallmouth bass with a 15-inch minimum size limit.

A trophy trout fishing area is established on the Meramec River (except Maramec Spring Branch) in Crawford and Phelps counties from Missouri Highway 8 Bridge to Scott's Ford. Regulations are as follows: 1) Daily and possession limit is three trout of any species. 2) Minimum length limit is 15-inch. 3) Only flies and artificial lures may be used--synthetic eggs and soft plastic lures are specifically prohibited.

Because of the cold spring found in the 3.7-mile long stretch of Blue Springs Creek in Crawford County, from Blue Spring to its junction with Meramec River, a wild rainbow trout fishery exits. Wild trout management area regulations are as follows: 1) Daily and possession limit is one trout. 2) Trout must be 18-inch or greater in size to possess. 3) Only flies and artificial lures may be used--synthetic eggs, live bait, and soft plastic lures are specifically prohibited.

No changes in fishing regulations or further establishment of management areas are planned at this time. In recent years, however, management of fisheries has moved from the maximum sustained yield criterion to an optimum sustained yield criterion that is aimed at increasing angler satisfaction. Therefore, we manage the fishery so that it sustains the aquatic resource and responds to the needs of the recreational fishing public. Our angler surveys and biological sampling provide the necessary information to successfully manage fisheries for sustained recreational use.

Table 18. Fish species collected within the Meramec River basin. Represented are both Fisheries Research Section (Pflieger) and Fisheries Management Section with corresponding collection year.

Species Name	Research Collection Year	Management Collection Year
\ <u> </u>	Large (species that obtain six inches or more a	as adults)
Alosa alabamae (Alabama shad)	1954,47 to 57	1987,88, 96
Alosa chrysochloris (Skipjack herring)	1954,47 to 57,61	1987
Ambloplites rupestris (Rock bass)	1941,42,54,47 to 57,61,63,67,77,84,92	1986,87,88,89,90,91,92,94,95,96
Ameiurus melas (Black bullhead)	1930,41,47 to 57,61,84	1986,91
Ameiurus catus (White catfish)		1989
Ameiurus natalis (Yellow bullhead)	1933,41,54,47 to 57,63,67,74,92	1986,87,91,94,95,96
Amia calva (Bowfin)		1989
Anguilla rostrata (American eel)	1954,47 to 57,61	1986,87,89,92
Aplodinotus grunniens (Freshwater drum)	1941,47 to 57,61,63	1986,87,88,89,90,91,92,94
Carpiodes carpio (River carpsucker)	1942,54,47 to 57,63	1986,87,88,89,90,91
Carpiodes cyprinus (Quillback)	1954,47 to 57,61	1987,88,89,91,92
Carpiodes sp.		1996
Carpiodes velifer (Highfin carpsucker)	1954,47 to 57,63	1989,90,91,94

Catostomus commersonni (White sucker)	1941,47 to 57,61,63,74,76,77	1991,95
Ctenopharyngodon idella (Grass carp)		1992
Cycleptus elongatus (Blue sucker)	1954,63	
Cyprinus carpio (Common carp)	1941,54,47 to 57,61,63	1986,87,88,89,90,91,94,95
Dorosoma cepedianum (Gizzard shad)	1941,42,54,47 to 57,61,63,92	1986,87,88,89,90,91,92,94,95,96
Esox americanus (Grass pickerel)	1941,54,47 to 57,61,63,77,92	1986,87,95,96
Esox lucius (Northern pike)	1947 to 57,63	
Erimyzon oblongus (Creek chubsucker)		1992
Hiodon alosoides (Goldeye)	1954,63	1987,89,91
Hiodon tergisus (Mooneye)	1954,47 to 57,63	1987,88,89,90,91,92
Hypentelium nigricans (Northern hog sucker)	1941,42,54,47 to 57,61,63,67,74,82,92	1986,87,88,89,90,91,92,94,95,96
Ichthyomyzon castaneus (Chestnut lamprey)	1954,47 to 57,61,63	1986,89
Ictalurus punctatus (Channel catfish)	1941,54,47 to 57,61,63	1986,87,88,89,90,91,95
Ictiobus bubalus (Smallmouth buffalo)	1954,47 to 57,63	1986,87,88,89,90,91

Ictiobus cyprinellus	1954,47 to 57	1986,87,89,91
(Bigmouth buffalo)	,	
Ictiobus niger (Black buffalo)	1954	1987,89,90
Lepisosteus oculatus (Spotted gar)	1954	
Lepisosteus osseus (Longnose gar)	1942,54,47 to 57,61,63	1986,87,89,90,91,92,94
Lepisosteus platostomus (Shortnose gar)	1954,47 to 57,63	1986,87,88,89,90,91,95
Lepomis cyanellus (Green sunfish)	1930,41,42,54,47 to 57,61,62,63,67,74,76,77,82,83,84,92	1986,87,89,91,92,94,95,96
Lepomis gibbosus (Pumpkinseed)	1963	
Lepomis gulosus (Warmouth)	1941,54,47 to 57,63	1987,91,92,96
Lepomis humilis (Orangespotted sunfish)	1941,42,54,47 to 57,63	1991
Lepomis macrochirus (Bluegill)	1941,42,54,47 to 57,61,63,67,74,76,77,84,92	1986,87,88,89,90,91,92,94,95,96
Lepomis macrochirus x Lepomis megalotis (Bluegill x longear sunfish)		1986,87,91,95
Lepomis megalotis (Longear sunfish)	1941,42,54,47 to 57,61,63,67,74,77,84,92	1986,87,88,89,90,91,92,94,95,96
Lepomis microlophus (Redear sunfish)	1961,92	1987,95,96
Lepomis punctatus (Spotted sunfish)	1947 to 57	

Micropterus dolomieu (Smallmouth bass)	1941,42,54,47 to 57,61,63,67,74,77,84,92	1986,87,88,89,90,91,92,94,95,96
Micropterus dolomieu x Micropterus punctulatus (Smallmouth bass x Spotted bass)		1988
Micropterus punctulatus (Spotted bass)		1986,87,88,89,90,91,92,94,96
Micropterus salmoides (Largemouth bass)	1941,54,47 to 57,61,63,67,74,82,92	1986,87,88,89,90,91,92,94,95,96
Minytrema melanops (Spotted sucker)	1941,47 to 57,61,92	1986,87,91,92,95,96
Morone chrysops (White bass)	1954,47 to 57	1987,89,91,94
Morone saxatilis (Striped bass)		1989
Moxostoma anisurum (Silver redhorse)	1954,47 to 57,61,63	1987,89
Moxostoma carinatum (River redhorse)	1954,47 to 57,61,63	1986,87,88,89,90,91,92,94,95
Moxostoma duquesnei (Black redhorse)	1941,42,54,47 to 57,61,63,92	1986,87,88,89,90,91,92,94,95,96
Moxostoma erythrurum (Golden redhorse)	1941,42,54,47 to 57,61,63,84,92	1986,87,88,89,90,91,92,94,95,96
Moxostoma macrolepidotum (Shorthead redhorse)	1941,54,47 to 57,61,63	1986,87,88,89,90,91,92,94,95
Oncorhynchus mykiss (Rainbow trout)	1947 to 57,61,63	1995
Pomoxis annularis (White crappie)	1941,54,47 to 57,61,63	1986,87,89,90,91,92

Pomoxis annularis x		1988
Pomoxis nigromaculatus (White		1500
crappie x Black crappie)		
Pomoxis nigromaculatus (Black crappie)	1941,54,47 to 57,61,63	1986,87,89,91
Pylodictis olivaris (Flathead catfish)	1954,47 to 57,61,63	1986,87,88,89,90,91,96
Salmo trutta (Brown trout)		1995
Stizostedion canadense (Sauger)	1954,63	1986,87,88,89,90,91
Stizostedion vitreum (Walleye)	1954,47 to 57,61,63	1986,87,88,91
	Benthic (smaller, bottom-dwellers)	
	<u> </u>	
	10.40	
Ammocrypta clara (Western sand darter)	1942	
Cottus bairdi (Mottled sculpin)		1991,92,94,95,96
Cottus carolinae (Banded sculpin)	1946,61,77,84,92	1986,91,92,95,96
Cottus hyoselurus (Ozark sculpin) ¹	1933,41,46,54,47 to 57,61,62,63,67,74,76,77,82,84,92	
Crystallaria asprella (Crystal darter)	1954,47 to 57	1991,96
Erimystax x-punctatus (Gravel chub)	1941,42,46,54,47 to 57,61,63,92	1991,95,96
Etheostoma asprigene (Mud darter)	1963	
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Etheostoma blennioides (Greenside darter)	1941,42,54,47 to 57,61,63,67,77,84,92	1986,91,92,95,96
Etheostoma caeruleum (Rainbow darter)	1933,41,42,46,54,47 to 57,61,62,63,67,74,76,77,82,84,92	1991,92,95,96
Etheostoma f flabellare (Barred fantail darter)		1992,94,95,96
Etheostoma f lineolatum (Striped fantail)	1933,41,47 to 57,61,62,63,67,76,77,82,84,92	1995
Etheostoma nigrum (Johnny darter)	1930,47 to 57,63,74,77,92	1991,95,96
Etheostoma s spectabile (Northern orangethroat darter)	1930,33,41,42,46,54,47 to 57,61,62,63,67,74,76,77,82,83,84,92	1991,92,94,95,96
Etheostoma tetrazonum (Missouri saddled darter)	1941,42,46,54,47 to 57,61,63,77,84,92	1992,95,96
Etheostoma zonale (Banded darter)	1941,46,54,47 to 57,61,77,84,92	1995,96
Ichthyomyzon (Larval lamprey)	1947 to 57,61,92	1995,96
Ichthyomyzon fossor (Northern brook lamprey)	1947 to 57,61,63,67	
Noturus exilis (Slender madtom)	1933,41,46,47 to 57,61,62,67,74,77,82,83,84,92	1991,92,94,95,96
Noturus flavus (Stonecat)	1946,54,47 to 57,61,77,92	
Noturus nocturnus (Freckled madtom)	1941,42,54,47 to 57	
Percina c caprodes (Ohio logperch)	1941,54,47 to 57,61,63	1986,91,95,96

Percina c fulvitaenia (Ozark logperch)	1992	
Percina evides (Gilt darter)	1941,42,54,47 to 57,61,63,77,92	1996
Percina maculata (Blackside darter)	1954	
Percina phoxocephala (Slenderhead darter)	1941,42,54,47 to 57,63	
Percina shumardi (River darter)	1954,63	
Phenacobius mirabilis (Suckermouth minnow)	1942,54,63,74,77	
<u>Ne</u>	ktonic (mostly live above the substrate and inhabit pools and dec	eper water)
Campostoma anomalum (Central stoneroller)	1930,33,41,47 to 57,54,61,62,63,67,74,76,77,82,83,84,92	1986,87,91,92,94,95
	1930,33,41,47 to 57,54,61,62,63,67,74,76,77,82,83,84,92 1933,41,42,46,47 to 57,54,61,62,63,67,74,76,77,84,92	1986,87,91,92,94,95
(Central stoneroller) Campostoma oligolepis		
(Central stoneroller) Campostoma oligolepis (Largescale stoneroller)		1991,95
Campostoma oligolepis (Largescale stoneroller) Campostoma sp. Cyprinella lutrensis	1933,41,42,46,47 to 57,54,61,62,63,67,74,76,77,84,92	1991,95
Campostoma oligolepis (Largescale stoneroller) Campostoma sp. Cyprinella lutrensis (Red shiner) Cyprinella whipplei	1933,41,42,46,47 to 57,54,61,62,63,67,74,76,77,84,92	1991,95

Erimyzon sucetta (Lake	1961,63	
chubsucker)		
Fundulus catenatus (Northern studfish)	1930,33,41,42,46,47 to 57,54,61,62,63,67,74,76,77,82,84,92	1991,92,95,96
Fundulus notatus (Blackstripe topminnow)	1930,41,54,47 to 57,61,62,63	1991,92,94,95,96
Fundulus olivaceous (Blackspotted topminnow)	1954,61,62,63,67,74, 76,77,84,92	1991,92,95,96
Gambusia affinis (Mosquitofish)	1963,74,76,84,92	1987,92,95,96
Hybognathus nuchalis (Mississippi silvery minnow)	1942,47 to 57,54	
Labidesthes sicculus (Brook silverside)	1941,42,47 to 57,54,61,63,74,77,82,84,92	1995,96
Luxilus chrysocephalus (Striped shiner)	1933,41,42,47 to 57,54,61,62,63,67,74,76,77,83,84,92	1991,92,95,96
Luxilus cornutus (Common shiner)		1991
Luxilus zonatus (Bleeding shiner)	1933,41,42,46,47 to 57,54,61,62,63,67,77,82,84,92	1991,92,94,95,96
Lythrurus u yanocephalus (Eastern redfin shiner)	1930,41,46,47 to 57,54,61,63,74,77,92	1995,96
Hybopsis storeriana (Silver chub)	1954	
Nocomis biguttatus (Hornyhead chub)	1933,41,42,46,47 to 57,54,61,62,63,67,77,82,84,92	1986,91,92,95,96
Notemigonus crysoleucas (Golden shiner)	1930,41,54,63,77,82, 84	1986,91,92

Notropis boops (Bigeye shiner)	1930,41,42,47 to 57,54,63,61,74,77,84,92	1991,94,95,96		
Notropis amblops (Bigeye chub)	1930,33,41,42,47 to 57,54,61,63,77,84,92	1995,96		
Notropis amnis (Pallid shiner)	1954			
Notropis atherinoides (Emerald shiner)	1942,47 to 57,54,63,77	1991,95,96		
Notropis blennius (River shiner)	1963			
Notropis buccatus (Silverjaw minnow)	1941,63,74	1994,95,96		
Notropis buchanani (Ghost shiner)	1954,63,77			
Notropis dorsalis (Bigmouth shiner)	1947 to 57,63	1992,94		
Notropis greenei (Wedgespot shiner)	1941,42,46,47 to 57,54,61,63,67,77,84,92	1996		
Notropis nubilus (Ozark minnow)	1933,41,47 to 57,54,61,62,63,67,74,77,84,92	1991,92,95,96		
Notropis rubellus (Rosyface shiner)	1941,42,46,47 to 57,54,61,63,77,84,92	1995,96		
Notropis shumardi (Silverband shiner)	1963			
Notropis stramineus (Sand shiner)	1930,41,42,47 to 57,54,63,74,76,77	1991,95,96		
Notropis volucellus (Mimic shiner)	1941,42,47 to 57,54,61,63,77,92	1992,95		

Notropis wickliffi (Channel shiner)	1963	
Phoxinus erythrogaster (Southern redbelly dace)	1941,61,62,63,67,74,76,77,82,83,84, 92	1991,92,95
Pimephales notatus (Bluntnose minnow)	1930,41,42,46,47 to 57,54,61,62,63,74,76,77,84,92	1991,92,95,96
Pimephales promelas (Fathead minnow)	1941,54,63,74	1989,91
Pimephales vigilax (Bullhead minnow)	1942,54,63,77	
Platygobio gracilis (Flathead chub)	1963	
Semotilus atromaculatus (Creek chub)	1941,47 to 57,61,62,63,67,74,76,77,82,83,92	1991,92,94,95

Table 19. Numbers and relative abundance of living naiades found in the Meramec River (USGS Code #07140102) and some of its major tributaries. (Buchanan 1980)

Species	Meramec	Meramec River		Huzzah Ck.		tois Ck.	Dry Fork	
	No.	%	No.	%	No.	%	No.	%
Cumberlandia monodonta (Spectacle case)	456	4.8						
Anodonta imbecillis (Paper pond shell)	5	0					3	1.1
Anodonta g. grandis (Floater)	156	0					28	10.6
Anodonta grandis corpulenta (Stout floater)	35	0						
Anodontoides ferussacianus (Cylindrical paper-shell)	0	0						
Strophitus u. undulatus (Squaw foot)	88	0					8	3
Alasmidonta marginata (Elk-toe)	28	0			16	6.8		
Alasmidonta viridis (Slipper-shell)	21	0			9	3.8		
Arcidens confragosus (Rock pocketbook)	11	0						
Simpsonaias ambigua (Salamander mussel)	0	0						
Lasmigona complanata (White heel-splitter)	16	0					12	4.5
Lasmigona costata (Fluted shell)	40	0					2	0.8
Megalonaias nervosa (Washboard)	585	0						
Tritogonia verrucosa (Buckhorn)	9	0						
Quadrula quadrula (Maple-leaf)	80	0						
Quadrula metanevra (Monkey-face)	33	0						
Quadrula pustulosa (Pimple-back)	545	0						
Amblema p. plicata (Three-ridge)	2094	0					25	9.4
Fusconaia ebena (Ebony shell)	4	0						
Fusconaia flava (Pig toe)	216	0			3	1.3		
Cyconaias tuberculata (Purple warty-back)	78	0						
Plethobasus cyphyus (Bullhead)	39	0						
Pleurobema coccineum (Round pig-toe)	225	0						
Elliptio c. crassidens (Elephant's ear)	0	0						

Elliptio dilatata (Lady-finger)	513	0						
Obliquaria reflexa (Three-horned warty-back)	33	0						
Actinonaias ligamentina carinata (Mucket)	2441	0						
Venustaconcha e. ellipsiformis (Ellipse)	92	0	1	1.3	26	11	5	1.9
Plagiola lineolata (Butterfly)	82	0						
Truncilla truncata (Dear-toe)	64	0						
Truncilla donaciformis (Fawn's foot)	9	0						
Leptodea leptodon (Scale shell)	9	0						
Leptodea fragilis (Fragile paper-shell)	37	0					6	2.3
Potamilus alatus (Pink heel-splitter)	304	0					7	2.6
Potamilus ohiensis (Fragile heel-splitter)	18	0						
Toxolasma parvus (Lilliput mussel)	0	0					4	1.5
Ligumia recta (Black sand-shell)	126	0						
Ligumia subrostrata (Pond mussel)	0	0					3	1.1
Lampsilis t. teres (Slough sand-shell)	60	0						
Lampsilis teres anodontoides (Yellow sand-shell)	2	0						
Lampsilis radiata luteola (Fat mucket)	1	0					92	34.7
Lampsilis orbiculata (Pink mucket pearly mussel)	19	0						
Lampsilis ventricosa (Pocketbook)	176	0	1	1.3	1	0.4	70	26.4
Lampsilis reeviana brittsi (Britt's shell)	720	0	73	96.1	182	76.9		
Epioblasma triquetra (Snuffbox)	0							
Total	9,470		75		237		265	

Table 20. Location of crayfish species within the Meramec River basin and the percent composition upon the date of collection (Missouri Department of Conservation, Pflieger Collection).

Scientific Name	Basin	Stream	Twn	Rng	Sec	Mile Head	Date	Total #Individuals	% Comp.
Cambarus diogenes (trace)	2	Meramec River	37N	05W	6	50	10/24/85	1	3.
Cambarus maculatus	2	Meramec River	37N	05W	6	50	10/24/85	5	15.
Total: 41 species (3.4%)	2	Meramec River	37N	05W	6	50	5/5/86	5	13.
	3	Huzzah Creek	37N	02W	6	38	10/23/86	5	17.
	3	Huzzah Creek	38N	03W	11	45	3/4/77	1	33.
	4	Hazel Creek	36N	01W	19	5	10/18/84	9	4.
	4	Hazel Creek	36N	01W	19	5	3/25/85	7	5.
	4	Hazel Creek	36N	01W	19	5	5/5/86	3	7.
	4	Courtois Creek	35N	01W	33	31	2/22/88	3	5.
	7	Meramec River	40N	02W	13	116	3/4/77	1	12.
	8	Meramec River	44N	04E	32	194	10/1/87	2	2.
Orconectes harrisoni* (0.9%)	8	Meramec River	44N	04E	32	194	10/1/87	12	14.
Orconectes hylas (trace)	3	Huzzah Creek	36N	02W	29	20	3/27/84	1	0.
Orconectes luteus	2	Meramec River	36N	05W	12	38	5/31/84	25	52.
Total: 215 species (17.8%)	2	Meramec River	37N	05W	6	50	5/5/86	20	52.
	2	Meramec River	37N	05W	6	50	10/24/85	10	31.
	2	Unnamed Creek	36N	03W	33	1	10/10/83	1	2.
	2	Meramec River	34N	04W	19	13	3/30/84	2	6.
	3	Huzzah Creek	36N	02W	29	20	3/27/84	33	25.
	3	Huzzah Creek	37N	02W	6	38	10/23/86	5	17.
	3	Huzzah Creek	38N	03W	11	45	3/4/77	2	66.
	4	Hazel Creek	36N	01W	19	5	10/18/84	18	8.
	4	Hazel Creek	36N	01W	19	5	5/5/86	14	35.
	4	Hazel Creek	36N	01W	19	5	3/25/85	17	12.
	7	Meramec River	40N	02W	13	116	3/4/77	6	75.
	8	Meramec River	44N	04E	32	194	10/1/87	62	75.
Orconectes medius	2	Stone Hill Branch	34N	04W	35	4	9/20/85	32	80.
Total: 697 species (57.9%)	2	Stone Hill Branch	34N	04W	35	4	6/8/82	140	95.
	2	Meramec River	37N	05W	6	50	5/5/86	9	23.
	2	Meramec River	37N	05W	6	50	10/24/85	10	31.
	2	Meramec River	34N	04W	19	13	3/30/84	6	19.
	2	Unnamed Creek	37N	05W	5	1	9/28/84	7	46.
	3	West Fork Huzzah Creek	34N	03W	22	5	2/4/87	15	93.
	3	Huzzah Creek	36N	02W	29	20	3/27/84	50	38.
	3	Huzzah Creek	37N	02W	6	38	10/23/86	19	65.
	4	Hazel Creek	36N	01W	19	5	10/18/84	175	84.

	4	Courtois Creek	35N	01W	33	31	2/22/88	36	69.2
	4	Hazel Creek	36N	01W	19	5	3/25/85	100	75.2
	4	Hazel Creek	36N	01W	19	5	5/5/86	14	35.0
	5	Hamilton Creek	40N	01W	29	3	11/14/85	83	97.6
	7	Meramec River	40N	02W	13	116	3/4/77	1	12.5
Orconectes punctimanus	1	Dry Fork	34N	06W	7	17	10/24/85	8	100.0
<u>Total: 237 specimens</u> (19.7%)	2	Meramec River	34N	04W	19	13	3/30/84	23	74.2
	2	Meramec River	36N	05W	12	38	5/31/84	23	47.9
	2	Meramec River	37N	05W	6	50	5/5/86	4	10.5
	2	Meramec River	37N	05W	6	50	10/24/85	6	18.8
	2	Stone Hill Branch	34N	04W	35	4	9/20/85	8	20.0
	2	Stone Hill Branch	34N	04W	35	4	6/8/82	6	4.1
	2	Meramec River	34N	04W	33	9	6/8/82	9	100.0
	2	Unnamed	37N	05W	5	1	9/28/84	8	53
	2	Cutoff Pool	36N	05W	12		5/31/84	3	100.0
	3	West Fork Huzzah Creek	34N	03W	22	5	2/4/87	1	6
	3	Huzzah Creek	36N	02W	29	20	3/27/84	47	35.9
	3	Unnamed Creek	36N	03W	33	1	10/10/83	36	97.
	4	Courtois Creek	35N	01W	33	31	2/22/88	13	25.0
	4	Hazel Creek	36N	01W	19	5	5/5/86	9	22.5
	4	Hazel Creek	36N	01W	19	5	3/25/85	9	6.8
	4	Hazel Creek	36N	01W	19	5	10/18/84	6	2.9
	5	Hamilton Creek	40N	01W	29	3	11/14/85	2	2.4
	7	Fox Creek	43N	03E	4	7	3/22/86	10	100.0
	8	Meramec River	44N	04E	32	194	10/1/87	6	7.3
Vatch Listed Species							Total:	1,203	

1: Dry Fork 3: Huzzah Creek 5: Mid-Meramec 7: Lower-Middle Meramec

2: Upper Meramec 4-Courtois Creek 6: Indian Creek 8: Lower Meramec

Table 21. Crayfish species diversity (Shannon) and richness (Margalef) within watersheds of the Meramec River basin (Missouri Department of Conservation Pflieger Collection).

Basin	Stream Name	Mile Head	No. of Species	Average Shannon Total (n)	Average Margalef Total (n)
Dry Fork	Dry Fork	17	1	0.000(1)	0.000(1)
Upper Meramec	Meramec River	13-50	5	1.008(3)	0.705(3)
	Stone Hill Branch	4	2	0.336(2)	0.236(2)
	Unnamed Creek	1	2	0.691(1)	0.369(1)
	Cutoff pool		1	0.000(1)	0.000(1)
	Meramec River	9	1	0.000(1)	0.000(1)
Huzzah Creek	Huzzah Creek	20-45	3	0.880(3)	0.706(3)
	Unnamed Creek	1	2	0.124(1)	0.277(1)
	West Fork Huzzah Creek	5	2	0.234(1)	0.361(1)
Courtois Creek	Hazel Creek	5	5	0.892(3)	0.663(3)
	Courtois Creek	31	3	0.766(1)	0.506(1)
Middle Meramec	Hamilton Creek	3	2	0.111(1)	0.225(1)
Lower Middle Meramec	Meramec River	116	3	0.736(1)	0.962(1)
	Fox Creek	10	1	0.000(1)	0.000(1)
Lower Meramec	Meramec River	194	4	0.775(1)	0.681(1)

(n)=number of collections

Mile Head= distance in miles to headwaters

Table 22. List of aquatic invertebrates within the Meramec River basin (MDC Fisheries Research printout 1995).

	PLECOPTERA (Stoneflies)	
Acroneuria internata	Isoperla namata	Perlesta sp.
Acroneuria sp.	Isoperla mobri	Perlesta placida
Acroneuria evoluta	Isoperla sp.	Perlidae
Agnetina sp.	Isoperla richardsoni	Perlinella drymo
Allocapnia vivpara	Leuctra sp.	Perlinella sp.
Allocapnia sp.	Nemoura sp.	Perlodidae
Alloperla sp.	Neoperla clymene	Prostoia sp.
Amphinemura delosa	Neoperla sp.	Pteronarcyidae
Brachypterinae	Oemopteryx sp.	Pteronarcys sp.
Hydroperla crosbyi	Paracapnia sp.	Strophopteryx sp.
Hydroperla sp.	Paragnetina sp.	Taeniopteryx maura
		Taeniopteryx sp.
	EPHERMEROPTERA (Mayfli	es)
Acentrella sp.	Ephemera sp.	Hexagenia atrocaudata
Anthopotamus sp.	Ephemerella argo	Isonychia sp.
Baetinae	Ephemerella needhami	Leptophlebia sp.
Baetis sp.	Ephemerella invaria	Neoephemera bicolar
Baetisca obesa	Ephemerella sp.	Paraleptophebia moerens
Baetisca sp.	Ephemerella subvaria	Rhithrogena sp.
Caenis sp.	Ephoron album	Seriatella sp.
Callibaetis sp.	Eurylophella sp.	Stenacron sp.
	Heptagenia sp.	Stenonema pulchellum
Choroterpes sp.		
Choroterpes sp. Cloeon sp.	Heterocloeon sp.	Stenonema sp.
		Stenonema sp. Traverella sp.

0	DONATA Anisoptera (Dragonfl	lies)	
Aeshna	Hagenius brevistylus	Ophiogomphus sp	
Dromogomphus sp.	Libellulidae	Progomphus sp.	
Gomphidae	Macromia sp.		
<u>C</u>	DONATA Zygoptera (Damselfl	ies)	
Agropmodae	Argia sp	Hetaerina sp.	
Aeshna	Calopteryx		
	TRICHOPTERA (Caddisflies)		
Agapetus sp.	Hydropsyche sp.	Ochrotrichia sp.	
Agraylea sp.	Hydropsyche betteni	Oecetis avara	
Brachycentrus sp.	Hydropsyche simulans	Oecetis inconspicua	
Ceraclea sp.	Hydroptila sp.	Oecetis sp.	
Cheumatopsyche sp.	Hydroptilidae	Oxyethira sp.	
Chimarra obscura	Ironoquia sp.	Phryganea sp.	
Chimarra socia	Leptoceridae	Polycentropus sp.	
Chimarra aterrima	Limnephilidae	Polycentropus sp.	
Chimarra sp.	Marilia sp.	Protoptila sp.	
Chimarra feria	Nectopsyche sp.	Psychomia flavida	
Glossosoma sp.	Neophylax sp.	Psychomyiidae	
Glyphopsyche missouri	Neophylax fuscus	Ptilostomis sp.	
Helicopsyche borealis	Neotrichia sp.	Pycnopsyche sp.	
Hydrophysche frisoni	Neureclipsis crepuscularis	Rhyacophila sp.	
Hydropsyche cuanis	Neureclipsis sp.	Setodes	
Hydropsyche aerata	Nyctiophylax sp.	Triaenodes sp.	
		Wormaldia sp.	

	<u>COLEOPTERA</u> (Beetles)					
Agabus sp.	Enochrus sp.	Macronychus glabratus				
Anchodemus sp.	Gonielmis sp.	Microcylloepus sp.				
Berosus sp.	Gyrinus sp.	Onychylis sp.				
Chaetarthria sp.	Helichus sp.	Optioservus sandersoni				
Dineutus sp.	Helophorus sp.	Paracymus sp.				
Dryops sp.	Hydaticus sp.	Peltodytes sp.				
Dubiraphia sp.	Hydrobius sp.	Psephenus herricki				
Dytiscus sp.	Hydrophilidae	Sperchopsis sp.				
Ectopria nervosa	Laccobius sp.	Stenelmis sp.				
Elmidae	Lutrochus laticeps					
	DIPTERA (Flys)					
Antocha saxicola	Endochironomus sp.	Ormosia sp.				
Antocha sp.	Erioptera sp.	Pedicia sp.				
Atherix lantha	Euparyphus sp.	Pseudolimnophila sp.				
Atrichopogon sp.	Forcipomyia sp.	Psychoda sp.				
Bezzia	Glyptotendipes sp.	Simuliidae				
Ceratopogonidae	Hemerodromia sp.	Simulium sp.				
Chrysops sp.	Hexatoma sp.	Stratiomyidae				
Cricotopus sp.	Limnophila sp.	Tabanus sp.				
Culicoides sp.	Limonia sp.	Tanytarsus sp.				
Dicranota sp.	Microtendipes sp.	Tipula sp.				
Empididae	Odontomyia sp.	Tipula abdominalis				
	OTHER INSECTS					
Chauliodes sp.	Lepidoptera	Nigronia sp.				
Corydalus cornutus	Lethocerus sp.	Rhagovelia sp.				
Elophila sp.	Microvelia sp.	Sialis sp.				

Hymenoptera	Naeogeus sp.	Trepobates						
CRUSTACEA (Freshwater Shrimps)								
Amphipoda (immature)	Cambarus hubbsi	Hyallela azteca						
Asellus sp.	Gammarus sp.	Lirceus sp.						
Asellus brevicandus	Gammarus fasciatus	Orconectes sp.						
	GASTROPODA (Snails)							
Amnicola sp.	Fossaria sp.	Planorbidae						
Chauliodes sp.	Lymnaea sp.	Pleurocera sp.						
Elimia sp.	Physella sp	Sialis sp.						
Ferrissia sp.	Physidae	Viviparidae						
Ī	MISCELLANEOUS GROU	UPS						
Acari	Gordiida	Oligochaeta						
Bryozoa	Hirudinea	Tubellaria						
<u>Intolerant</u>								
Caddisfly: Order Trichoptera		Riffle Beetle: Order Coleoptera						
Dobsonfly (Hellgrammite):	Order Megaloptera	Stonefly: Order Plecoptera						
Gilled Snail: Phylum Mollusca		Water Penny: Order Coleoptera						
Mayfly: Order Ephemeroptera								
Moderately Tolerant								
Alderfly larva: Order Megaloptera		Dragonfly: Order Odonata						
Beetle Larva: Order Coleoptera		Fishfly larva: Order Megaloptera						
Clam: Phylum Mollusca		Scud: Class Crustacea						
Crane Fly: Order Diptera		Sowbug: Class Crustacea						
Crayfish: Order Crustacea		Watersnipe Fly Larva: Order Diptera						
Damselfly: Order Odonata								

Tolerant	
Aquatic Worm: Class Oligochaeta	Midge Fly Larva: Order Diptera
Blackfly Larva: Order Diptera	Pouch Snail: Phylum Mollusca
Leech: Class Hirudinea	Other snails

Table 23. Fish, crayfish, and mussels species collected in the Meramec River basin that inhabitat wetlands for part of their life cycle.

Scientific Name (Common Name)			
FISHES1	Labidesthes sicculus (Brook silverside)		
Ameiurus natalis (Yellow bullhead)	Lepisosteus osseus (Longnose gar)		
Ameiurus melas (Black bullhead)	Lepisosteus oculatus (Spotted gar)		
Carpiodes carpio (River carpsucker)	Lepisosteus platostomus (Shortnose gar)		
Cyprinus carpio (Common carp)	Lepomis humilis (Orangespotted sunfish)		
Dorosoma cepedianum (Gizzard shad)	Lepomis punctatus (Spotted sunfish)		
Erimyzon oblongus (Creek chubsucker)	Lepomis gulosus (Warmouth)		
Erimyzon sucetta (Lake chubsucker)*	Lepomis microlophus (Redear sunfish)		
Esox americanus (Grass pickerel)	Lepomis macrochirus (Bluegill)		
Esox lucius (Northern pike)*	Lepomis cyanellus (Green sunfish)		
Esox americanus (Grass pickerel)	Lythrurus u cyanocephalus (Eastern redfin shiner)		
Etheostoma asprigene (Mud darter)	Micropterus salmoides (Largemouth bass)		
Fundulus notatus (Blackstripe topminnow)	Notemigonus crysoleucas (Golden shiner)		
Fundulus olivaceous (Blackspotted topminnow)	Pimephales vigilax (Bullhead minnow)		
Gambusia affinis (Mosquitofish)	Pimephales notatus (Bluntnose minnow)		
Hiodon alosoides (Goldeye)	Pimephales promelas (Fathead minnow)		
Ictiobus cyprinellus (Bigmouth buffalo)	Pomoxis annularis (White crappie)		
Ictiobus niger (Black buffalo)	Pomoxis nigromaculatus (Black crappie)		
CRAYFISH 1	MUSSELS ²		
Cambarus diogenes (Devil crayfish)	Corbicula spp. (Asiatic clam)		
	Anodonta grandis grandis (Floater mussel)		
	Actinonaias ligametina carinata (Mucket mussel)		
	Toxolasma panvus (Lilliput mussel)		

^{*} State listed as rare species.

¹Missouri Department of Conservation Pflieger Fish Collection

²Missouri Department of Conservation 1980

Table 24. Regulation experiment to improve fishing.

Survey	Investigator/Year	Years Surveyed	Purpose	Findings
Creel Census of Huzzah and Courtois creeks	Fleener 1971	1958-68	Estimate annual fishing pressure and catch	80% of catch under 12 in.
Harvest of fish from Huzzah Creek	Fleener 1974	1969-73	Effects of 12 in. length limit on Smallmouth Bass on fish harvest.	Fish harvest increased to 35.5 lbs/acre. 12 in. limit was effective.
Harvest of fish from Courtois Creek	Fleener 1974	1969-73	Evaluate the effect of catch-and-release on Smallmouth Bass.	Fish harvest increase to 40.5 lbs/acre. 12 in. limit was effective.